Remarks

I. INTERVIEW SUMMARY.

The claims presently pending have been rejected only as double-patented based on the non-statutory (Schneller) type of double patenting. Applicant's undersigned attorney and the Examiner participated in a telephone interview with the group's Special Programs Examiner, Mr. Marcus, on July 30, 1996, to discuss the scope of Schneller-type rejections, in general without regard to the specifics of this application, which Mr. Marcus had not reviewed.

Mr. Marcus explained that it was not the Patent Office's view, as he understood it, to apply Schneller to reject all continuation (not divisional) applications. Instead, the essence of the discussion was as follows: Schneller applies to reject claims in the form of ABCXY over a prior patent to ABCX (as those designations are used in Schneller), because a patent to ABCX "covers" any machine that also infringes ABCXY, in the sense of infringement. Also, it was possible to stretch the Schneller decision to reject ABCY based on a prior patent to ABCX, so long as both ABCX and ABCY would both cover a single, preferred embodiment. It is not possible, however, even under Schneller, to reject the combination of ABC and "not-X" based on a prior patent claiming ABCX, because there would be no extension of protection, because ABC-not-X would not infringe the prior patent, and it would not "cover" the invention. Also, Schneller would not cover certain cases where there was a combination-element situation, as in the case Schneller distinguished, in re Heinle.

Mr. Marcus further explained that, even if Schneller was stretched to permit rejections of ABCY based on ABCX, the Patent Office was not reading that decision as preventing a later patent to *any* ABCY, regardless of what X and Y were. Rather, the extension of the Schneller doctrine to ABCY (even if that extension is good law) should be interpreted as preventing an applicant from obtaining two sequential patents for a single disclosed embodiment. In other words, the question is whether, in a general sense, the later claim is directed to the "same thing" as the earlier patent. Mr. Marcus agreed that the Schneller opinion is poorly written, not analytically consistent, and difficult to apply.

Thus, Mr. Marcus advised that the Office's interpretation requires the Examiner to meet the burden of proving three things to maintain a Schneller rejection: (1) that the claims were presented voluntarily in this application and that there was no reason blocking presentation of the claims in the application that led to the previous patent; (2)

that the claims are directed to the same invention (in a general sense); and (3) that allowance of the claims would extend the protection of the earlier patent because the earlier patent "covers" the later-claimed invention. Here, where the Patent Office has lost the application file leading to the parent '256 Patent, and applicant does not have it either, Mr. Marcus agreed that the Examiner could not meet his burden.

Later that day, applicant and the Examiner conducted a further telephone interview, regarding the specifics of the parent '256 Patent and the present claims. Applicant pointed out two distinctions between the claims of the parent patent and certain of the present claims that the Examiner found persuasive in overcoming the Schneller distinction: (1) the parent patent is limited to tools that move along side of a conveyor, as opposed to stationary tools; and (2) the parent patent is limited to tools that operate on workpieces on the conveyor, as opposed to work that has been transferred off of the conveyor, for example to a work platform within range of the tool. The Examiner also conceded that it was not possible to meet his burden but asked that applicant explain, in detail, why Schneller should not apply to each of the claims regardless.

Applicant also advised the Examiner that he wished to obtain early allowance of the claims that were placed into the interference case, Serial No. 07/049,381, at the request of the prior examiner, Mr. Bilinsky. The Examiner confirmed that he had reached the conclusion that none of the claims transferred to the '381 case had been considered subject to the interference, and that only the claims directly copied from the Williamson reexamination certificate were interfering.

The Examiner stated that, barring any possible new rejection of the transferred claims, which issue the Examiner promised to evaluate, and assuming that the subject matter of the interview was properly recorded, he saw no reason for delay in issuing a notice of allowance. The Examiner further indicated that he had examined all of the claims, including the ones in the '381 case, and had determined that rejections for *obviousness*-type double patenting would not be appropriate.

On August 7, 1996, the undersigned and the Examiner met in person to discuss further reasons for the Schneller doctrine not applying to a variety of the claims, regardless of the burden of proof issue. The Examiner advised that he had, in the interim, reviewed the claims that applicant wished to transfer back from the copending '381 case for possible Schneller-type double patenting, but that he had concluded that no such rejection would be warranted. Applicant presented and (at the Examiner's

request) filed on that date an amendment cancelling the previously transferred claims from the '381 case. The Examiner briefly reviewed a draft of this response, and applicant explained the plan for transferring claims and their variants to this application. The parties discussed reasons why Schneller rejections would in any event be inappropriate in the August 7 meeting and in a follow-up telephone conversation on August 12, some of which reasons are outlined in Section III below.

Finally, in the August 12 telephone call, the Examiner explained that a proper Schneller rejection requires a showing that a claim rejected on that ground contains claim language to the same effect as every claimed element of an earlier-patented claim, or at least claim language from which every previous claim element is necessarily implied.

Applicant greatly appreciates the time and effort that the Examiner and Mr. Marcus have put into evaluating Schneller and explaining to the undersigned the Office's policy concerning how that case is being interpreted for all applicants.

II. THE AMENDMENTS HERE.

Applicant has made certain amendments to certain of the pending or transferred claims for purposes of clarifying the invention further or improving the form of the claims. For example, the phrase "machine tool" has been changed to "tool" in many of the claims, to clarify beyond dispute that the tool may or may not be one that performs "machining" in the strict sense of removal of material from the workpiece. Other minor or stylistic changes are also being made that are not considered to alter significantly the scope of the claimed inventions. Amendments have been presented, as well, to cure the rejections or objections under Section 112(2) in the Office Action of a few of the claims.

After entry of these amendments, the following claims ***only*** are being expressed in "means plus function" format and subject to the restrictions of Section 112(6): Claims 90-93, 137-140, 171-173, 176, 181-191, 196-205, and 210-214.

Following the amended claims from this case are newly presented claims 114-165, which are variants of the claims already pending, with modifications as discussed below. A comparison of those claims with the original claims of this application, showing how the original claims were amended to obtain these new claims, is attached as Exhibit A.

Next are newly presented claims 166-214, which are the claims being transferred back from the companion case 049,381. Certain amendments are made, principally as a matter of form, to the transferred claims, and those changes are shown on Exhibit B.

After that point are newly presented claims 215-370, which are variants of the claims being transferred from the companion case. Exhibit C shows the changes to those claims.

Also shown on Exhibit C is one newly worded independent claim (Claim 326) and a series of claims dependent thereon (claims 327-370). Claim 326 is directed to the same type of apparatus as previously claimed, specifically having a bypass feature, and it is thus not considered to present new issues for examination. The dependent claims are, for the most part, based on features that may be found in other claims already pending, thus they are also not considered to present new issues for examination. However, applicant has not attempted to show in Exhibit C the correlations to pre-existing claims.

In addition, applicant has added a string of "new" dependent claims to two of the variants of the independent claims being transferred from the '381 application, namely independent claims 215 and 281. The "new" dependent claims are variants of the same string of claims dependent on claim 326, mentioned in the last paragraph.

In other words, applicant has added dependent claims based on features previously applied to other independent claims to three other independent claims. Those three independent claims are based on claims transferred from the '381 application. In addition, a few other dependent claims have been added to Exhibit C, namely claims 267, 274, 278, 280, and 324.

In a few instances throughout the claims in the exhibits, certain dependent claims have been altered the change their dependencies or to split multiple elements into two parts. Those changes are shown with brackets and underlining in the exhibits.

Many of the claims previously pending either in this application or the copending '381 application lacked either of the two distinctions accepted initially by the Examiner as justifying withdrawal of the Schneller rejection (see part I above). However, variants of each of those claims are being presented (see Exhibits A and C) to ensure that there are claims that would contain those distinctions. Thus, Exhibits A and C contain claims that are variants of certain previously presented claims, with amendments to add either or both of those limitations.

III. RESPONSE TO SCHNELLER REJECTION.

There remains only one major ground of rejection of the claims of this application, for non-statutory double patenting under the doctrine of the Schneller case. Applicant has carefully reviewed the latest Office Action and, as detailed above, spent

considerable time with the Examiner and the group's Special Programs Examiner (who has been designated to coordinate this type of rejection within the group). Applicant thus understands that the persons examining this case do not consider themselves free to make the legal conclusion that the Schneller case does not extend the boundaries of double patenting to instances in which the claims are non-obvious variants of a previously patented claim, as applicant has previously argued in his last response. Applicant thus merely defers and preserves his arguments to that effect.

Instead, it is shown here that, unless the Schneller-based doctrine is applied so broadly as to prevent *all* continuations in which a restriction requirement was not *actually* entered in a parent application that became a patent, then there are ample reasons to decline to enter such a rejection in these circumstances.

A. <u>The "stationary tool" claims</u>.

A large group of claims cannot be rejected on Schneller-type double patenting because they contain limitations directed to stationary tools, which invention has not been covered by applicant's earlier patent. These include claims 114-120, 181-184, 198-205, 211, 215-257, 259-264, 267-272, 274-278, 280-322, and 324-370.

For example, independent claim 114 specifies that the tools are "located at respective stations," independent claims 181 and 268 each specify that the tools are "fixed-base" ones, independent claims 184, 215, and 326 each specify that the tools are "stationed," independent claim 261 specifies that the tools operate "from a stationary position," independent claim 198 specifies that each of the tools are "supported on a base that does not move during operation of the production system," independent claims 202, 205, 211, and 281 each specify that the tools are "stationed during operation" of the conveyor, and independent claim 275 specifies that the tools are "disposed during operation of said conveyor at different fixed locations."

The "during operation" verbiage was selected to clarify expressly that the tool may move in between operation of the system; for example, a tool may be wheeled or otherwise moved into place along a line or moved along a track and stationed at a fixed location throughout the time the apparatus is operated to convey workpieces past the tools. As certain dependent claims (some of which are new) clarify, it is not intended that the "stationary" nature of the tools in these claims exclude the possibility of moving parts, such as arms or moveable operating heads.

The claims in this group cannot possibly be subject to a Schneller rejection because the previously patented claims of the parent '256 Patent specify quite clearly

that the tools are capable of moving along the production line. In '256 Claim 1, a "trackway" and support for it are positively claimed, and each of the "automatic tools" is specified as "having respective tool transport means each of which is separately moveable in both directions along said trackway." In addition, there is "means for power driving each of said tool transport means to move along said trackway in wither direction...to preposition the respective tools at different locations along to trackway...," and "means for separately predeterminately controlling the movement of each tool transport means along said trackway." The other claims of the '256 Patent are to the same effect.

Thus, the parent claims do not "cover" the presently claimed invention. These claims meet the even stronger statement that there is no possibility that *any* apparatus that infringed the previous claim could also infringe the present claims of this group. The stronger statement does not qualify as an appropriate test even under Schneller. However, because the stronger test is met, there is no way that Schneller could apply, because there is no possible extension of applicant's patent coverage.

There may well be additional reasons why Schneller does not apply to some or all of the claims in this "group," even if the rejection is a proper one at all.

B. <u>The "offloading work" claims</u>.

A second large group of claims cannot be rejected on Schneller-type double patenting because they contain limitations directed to offloading work from the conveyor, which invention has not been covered by applicant's earlier patent. These include claims 66, 70, 121-165, 169-173, 176, 185-197, 212-214, 246, 258-260, 265-274, 279-280, 312, and 323-325.

For example, in independent claim 66, the "first control system" controls movement of each tool to a "work station," and the "second control system" also does "transferring [of] respective units of work to said work station." Independent claim 70 refers to "work stations" adjacent to the path along which the conveyor carries workpieces, and palletized work is secured at the work stations by "securing devices." Independent claim 176 is to similar effect, in that its "work locating and securing means" holds work "removed from the conveying means." The "pallet transfer and support means" of independent claim 185 includes similar securing system. The "pallet transfer devices" and "securing devices" of independent claim 192 is also similar. Independent claim 268 has a "positioning system" and "securing device" to hold work at the fixed tools.

In independent claim 265, a "locator" removes work from the conveyor and positioned it within range of a tool.

In independent claim 121, a "workpiece support" is "stationed adjacent to the conveyor..., to which support workpieces are fed from said conveyor" for tool operations. Independent claim 123 has "stationary work stations" adjacent to the conveyor and a "remote controller" that aligns work at the work stations. Similarly, independent claim 141 has tools structured to operate on work "supported at work stations adjacent to" the work conveyor and a "remote controller" that controls the work transporter "to transfer said work to a work station" for operation by the tools. In part (e)(2) of independent claim 152, it is specified that the remote controller controls the workpiece transporter "to position the work at selected work stations" for operation by the tools.

Independent claim 169 has "a transfer device system" that moves workpieces from the conveyor to select machine work stations. The "transport means" in independent claim 171, "means for selectively transferring a workpiect from said conveyor means" in independent claim 172, and "offloading means" in independent claim 173, "transfer means" of independent claim 186, "pallet transfer means" of independent claims 187 and 188, "means for transferring palletized work" of independent claim 196, "means for applying...control signals to effect the transfer" of work of independent claim 212, and the "transfer device" of independent claims 258, 279, and 323 are to similar effect.

In independent claim 273, a "movement control system" detaches separate work carriers from a work conveyor and a "positioning system" aligns the carried work with a tool.

Thus, all of the claims of this group contain limitations that variously specify that the tools operate on work that is transferred from, supported off of, or held at a station adjacent to the conveyor. By contrast, the claims of the parent '256 Patent specify that the moving tool is positioned "with respect to work carried by said conveying means," which therefore specifies that the tool operates on work *while on the conveyor.* (Independent '256 Claim 4 is to the same effect and further specifies that the work is in motion on the conveyor while the moving tool operates on it.)

Thus, the parent claims do not "cover" the presently claimed invention. These claims also meet the even stronger statement that there is no possibility that *any* apparatus that infringed the previous claim could also infringe the present claims of

this group. The stronger statement does not qualify as an appropriate test even under Schneller. However, because the stronger test is met, there is no way that Schneller could apply, because there is no possible extension of applicant's patent coverage.

There may well be additional reasons why Schneller does not apply to some or all of the claims in this "group," even if the rejection is a proper one at all.

C. <u>The "disposed tool" claims</u>.

A number of the claims that do not contain express limitations along the lines of those discussed above nevertheless should not be made subject to a Schneller rejection because they lack the elements of moving tools in the claims of the '256 Patent, even if, by happenstance, it is possible to construct a particular apparatus that would infringe both the claims of the '256 Patent and the claims in this group.

A number of the claims, for example, contain language specifying that the claims are "disposed" adjacent to the conveyor. At least claims 2, 77-81, 166-168, 177-180, and 206-210 (as well as a number of the claims in part B above) are of this type. Independent claims 11, 166, 206, 208, and 210 specify that the tools are "disposed" at locations along the production line, independent claim 2 specifies that the tools are "located...spaced apart from each other," and independent claim 177 specifies that the tools are "arranged to form a production line."

As noted in part A above, the claims of the '256 Patent expressly require bi-directional power-driven tool supports on a trackway. The presently pending "disposing" claims lack such limitations. Even if it is possible that, in certain cases, the tools could be "disposed" at the appropriate locations by moving them along a track, such is not *necessary* to the pending claims of this type. Thus, there are significant limitations of the prior patent lacking from the claims of this group, and the inventions being claimed by them are not "covered" by the claims of the '256 Patent.

There may well be additional reasons why Schneller does not apply to some or all of the claims in this "group," even if the rejection is a proper one at all.

D. <u>Certain of the remaining claims lack tool-conveyor synchronization</u>.

A number of the remaining claims (as well as some or all of the claims in the other groups of claims discussed above) lack important elements claimed in the parent '256 Patent, namely (1) movement of any given tool independent of the other tools' movement, and (2) "means for synchronizing" the tool transporter and the conveyor. Specifically, at least claims 16-25, 72, and 174-175 lack these elements. Also, claims 11-14 and 95 lack the synchronization means.

In independent claim 16, the "tool transporter" supports a plurality of tools, and there is no requirement that the tools be moveable independently from each other. Moreover, the controller in independent claim 16 controls only the "work transporter," that is, conveyor, and there is no "synchronizing" of movement of the tool transporters.

Independent claim 174 has no claim element relating to tool transporters, and there is no claim requirement that the tools move at all. Further, there is a conveyor and a controller that generates signals for application to the tool *operation*, but there is no claimed connection between the controller and the *conveyor*.

Independent claim 11 requires that the tools have the capacity of controlled movement, but there is no requirement of synchronization. Rather, the controller in part (d) could well control movement of the tools, *then* cause alignment of the workpieces by operation of the conveyor.

The Office Action states that the "means for synchronizing" is the central control circuitry shown at the left side of Figure 3 and in the associated specification. However, the central control circuitry is disclosed in the specification as accomplishing many separate functions. It is not proper to consider a prior patented claims as "covering" a separately claimed structure having different utility, merely because the separately claimed structure is part of a common superstructure.

Because the '256 Patent claims are limited in these fashions, the claims of that patent do not "cover" the invention presently claimed by the claims listed above.

E. Combination/element distinctions as to the remaining claims.

The following claims are the only ones not included in at least one of the lists above: Claims 6-10, 82-94, 96-98, and 100-113. Of those, only claims 6 and 96 are independent. The Schneller theory should not apply to those claims because they are related to the claims of the parent patent in a combination/element way.

Specifically, the parent patent claims include a combination (generally speaking) including, aside from the work conveyor, (a) a trackway supporting moving tool transporters, (b) tool transporters with bidirectional power drives and a tool head, (c) a control means governing independent movement of the various tool transporters, and (d) means for synchronizing the tool transporters and the conveyor. By contrast, some of the pending claims are directed to specifically claimed aspects of a subset of those elements, even reading the support for the parent claim as the Examiner does in the Office Action.

Independent claim 6 includes (aside from the work conveyor) details of the transported *tools*, including the (1) powered transport, (2) local controller, and (3) supported multi-part manipulator arms, as well as details of a remote controller, including the storage device. Using the form of analysis mentioned in Schneller, the parent patent can be expressed as ABCD, where those elements refer to the parts (a)-(d) in the previous paragraph. By contrast, claim 6 can be expressed as $B_1B_2B_3E_1E_2$, where B1 through B3 refer to the elements (1)-(3) of this paragraph and the E's refer to the remote controller with (1) storage and (2) command control signals.

Independent claim 96 supports a similar argument. That claim has parallel (but differntly worded) limitations to tool elements (1)-(3) discussed above, and it also has further features, such as the tools' local storage devices (part (b)(iv) of claim 96) and an added communications system, which can be referenced as F. Claim 96 can thus be modeled as $B_1B_2B_3B_4E_1E_2F$.

In Schneller itself, the Court distinguished the case of In re Heinle, thereby confirming that the Schneller doctrine (if it is viable) does not apply to instances where the earlier, patented claim related to a combination of elements and the later claim relates to further definition of one of those elements. In Heinle, for example, the previously patented claim related to an apparatus supporting toilet paper, while the later application (in which the double patenting rejection was overturned) claimed a specific toilet paper core that could be used in the system of the parent patent.

The thrust of claims 6 and 96 relate to the specified details of the tool structure and their interaction with the central controller (the B's and E's), and not the tool *transporter* structure, support, and control vis-a-vis the conveyor (ABCD). In other words, those claims relate to an invention that is a subset of the system claimed in the parent '256 Patent, as was the case with the Heinle case. The various dependent claims add additional details or elements, but the general point remains the same.

The addition of extra features, such as F above does not change the analysis, and the Heinle distinction must apply even if the later claim defines two of the original elements instead of one. The point illustrated by Schneller's distinction of Heinle is that an earlier combination does not block a later claim related to details of individual *elements* of the first-claimed combination.

This same line of analysis can equally well be applied to other of the claims in the earlier parts. For example, the first still pending claim, claim 2, is a different combination claim related to a command controller directing work by two tools on a

single workpiece located on an intermediate support. However, as this form of analysis is more complex, and as the distinctions discussed in parts A-D above are also available to overcome Schneller, it is not necessary to apply this form of analysis to each of the other claims.

F. The various embodiments in the specification.

As noted in the summary of the interviews, the argument for extending Schneller to the case of ABCX vs. ABCY requires, at a minimum, that the two claims (the prior patented one and the pending one) relate to the same general invention, and that they be supported by a single, preferred embodiment in the specification. In the case where the specification discloses a number of distinct embodiments, however, even the Schneller theory cannot justify a rejection of the claims.

Here, there are a large number of different embodiments disclosed in the specification. In some instances, there is common structure disclosed to perform distinct operations. Because the specification here is, in principal part, continued from the '256 Patent, applicant refers to the disclosure using column and line designations of the parent patent. However, yet further embodiments relying on the other line of parent cases are included in the specification of the present application that were not included in the '256 Patent.

In particular, in columns 18-19 of the '256 Patent, applicant discloses four "modes" of operation of the disclosed apparatus, which require use of different apparatus elements. In a "first mode," the tool is moved until a sensor strikes a workpiece, at which point the tool automatically initiates operation. In "one form" of the invention, the workpiece on the conveyor and the tools move in tandem while the tools operate on the workpiece. These are the "modes" to which the claims of the '256 Patent are directed.

However, applicant proceeds to discuss other modes. In a "second mode," a detection signal generated when the tool's sensor strikes a workpiece moving along the conveyor causes the workpiece to stop. The claims of the '256 Patent could relate to certain aspects of this "mode," in which the tools move into position and operate on workpieces located on the conveyor, but stopping the workpiece is not specificallly claimed.

In a "third mode," a machine tool is positioned at a work station adjacent to the conveyor, and the workpieces are transferred off of the conveyor. This was not claimed by the '256 Patent, but it is being claimed now, in the claimed listed in part B above.

In a "fourth mode," two tools work on two sides of a conveyed workpiece, such as from both sides of the line. This, too, is being claimed by certain of the claims in this application, such as claim 2, but was not covered by the '256 Patent.

Also, in column 17 of the '256 Patent, applicant discloses a number of different embodiments of the tool structure. Mentioned are tools mounted on floor, wall, or overhead, as well as tools moving along a track. The '256 Patent claims the moving tools, while a large subset of the pending claims (see part A above) relate to the other, distinct embodiments.

Similarly, with regard to (at least) the "disposed tool" claims (see part C above), columns 9-10 of the '256 Patent refer to tools that have some range of movement but which return to a "home" position at "different locations" along a production line. This embodiment, too, is distinct from the tools that are moveable anywhere along a trackway, which was claimed by the claims of the '256 Patent.

Alternative embodiments are disclosed and not previously claimed with regard to other elements discussed above, as well.

In sum, the '256 Patent was directed to different and distinct apparatus arrangements from the claims here.

G. <u>The failure to meet the Office's burden of proof</u>.

To date, the Office has failed to meet its burden of showing each of the elements of a valid Schneller-type rejection, if such a rejection is proper in the first place. Applicant notes that the Office Action contains the statement (at page 5), "A review of the file record indicates that there is no apparent reason why applicant was prevented from claiming and fully prosecuting the invention as now claimed in the parent application which matured into patent No. 3,559,256." That statement is not supportable, as has now been recognized, as indicated in the interview summary above.

In the July 30, 1996, telephone call, the Examiner advised that the Patent Office's computer records showed that the application file for the '256 Patent had been identified as lost in April 1985, more than ten years ago. Since that time, there have been approximately 20 "official searches" instituted for the file, but the Office has been unable to locate the file.

Applicant has searched for any file in his possession but has been unable to locate anything other than the published patent. He has recently corresponded with his former attorney, Mr. Smith, and a former assignee of certain parent patents, Molins PLC, as well as other persons who might have copies of the file. So far, he has been

entirely unable to locate the file either. The Patent Office's loss of the file precludes applicant from determining whether there was a restriction requirement in the application or the nature of any such requirement.

Applicant believes that the loss of the file may well not be simply a moot question. The file history of the companion '257 Patent contains comments by the examiner of that case (who was the same examiner of the '256 Patent) reminding applicant to keep the subject matter of the two cases directed to their respective inventions. It is thus quite likely that applicant was required to maintain the application leading to the '256 Patent directed to the single invention expressed in the claims as they ultimately issued.

H. Multiple reasons for not applying Schneller.

Although some of the claims are discussed only in connection with one of the arguments above, in many instances several of the arguments could apply. For example only, as to the following claims, both of the limitations in Parts A and B apply: Claims 246, 258-260, 267-272, 274, 280, 324-325. A number of those claims are dependent claims that add limitations parallel to those in one of those sections (parts A or B) to a claim that has limitations discussed on the other of those sections.

Applicant has not attempted an exhaustive catalog of the various applicable distinctions, because of the large number of claims and because it is not necessary to do so. Of course, the points made in parts F and G, as well as in applicant's last response concerning the deficiencies with the Schneller theory, apply to *all* claims.

Moreover, there are likely other reasons for not applying Schneller not mentioned above. For example, the Schneller court indicated that applicant could have avoided the rejection if he had met his burden of proving that the claims then presented were independent and distinct from the invention of the parent patent. Applicant could well do so here, as to all of the claims, both for the above reasons and more specifically, as a claim-by-claim examination would demonstrate.

Nevertheless, the above should be sufficient to overcome the rejection as to all claims, as discussed in the interviews. Applicant respectfully requests prompt issuance of a notice of allowance.

Conclusion

Applicant's attorney is available by telephone at any time to answer any questions regarding this matter or to expedite handling or assist the Office in any way deemed necessary.

Respectfully submitted,

JEROME H. LEMELSON
by his attorney

Dated: August 16, 1996

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Certification

I hereby certify that this paper, together with attached Exhibits A-C and a check for $6,728.00, is being hand-delivered this 19th day of August, 1996, to the U.S. Patent and Trademark Office.

By: _____
Name: Myron Tereshchuk

RECEIPT IS ACKNOWLEDGED OF a document entitled "Supplemental Amendment," together with attached Exhibits A-C and a check for $6,728.00:

"CONFIDENTIAL INFORMATION OF JEROME H. FELSON"

fms

114. [2.] An automatic production system comprising:

(a) a plurality of automatic tools, each provided with a respective tool controller and located at respective stations so that said tools are spaced apart from each other,

(b) at least one workpiece support positioned between a first and second of said stationary tools, and

(c) a command controller structured to control said first and second tools to operate simultaneously on at least one workpiece supported by said support by selectively (i) generating a plurality of signals as command control messages defining information for controlling operation of said selected tools, (ii) addressing said selected tools, and (iii) applying selected of said command control messages to respective tool controllers of said addressed tools to cause the selected tools controlled thereby to perform preprogrammed operations on said workpiece supported between said first and second tools.

115. [77.] The system of Claim [2] 114 wherein said workpiece support is moveable.

116. [78.] The system of Claim [77] 115 wherein said moveable workpiece support comprises a conveyor [that supports a plurality of workpieces].

117. [78.] The system of Claim [77] 116 wherein said [moveable workpiece support comprises a] conveyor that supports a plurality of workpieces.

118. [79.] The system of Claim [77] 115 wherein said workpiece support comprises a moveable pallet.

119. [80.] The system of Claim [77] 115 wherein said command controller also controls the movement of said workpiece support.

120. [81.] The system of Claim [2] 114 wherein said command controller includes a program store and a transducer that reproduces selected signals from the program store as command control messages.

121. [2.] An automatic production system comprising:

(a) a plurality of automatic tools, each provided with a respective tool controller and located so that said tools are spaced apart from each other,

(b) a workpiece conveyor,

[(b)] (c) at least one workpiece support [positioned] stationed adjacent to the conveyor and between a first and second of said tools, to which support workpieces are fed from said conveyor, and

[(c)] (d) a command controller structured to control said first and second tools to operate simultaneously on at least one workpiece supported by said workpiece support by selectively (i) generating a plurality of signals as

command control messages defining information for controlling operation of said selected tools, (ii) addressing said selected tools, and (iii) applying selected of said command control messages to respective tool controllers of said addressed tools to cause the selected tools controlled thereby to perform preprogrammed operations on said workpiece supported between said first and second tools.

122. [81.] The system of Claim [2] 121 wherein said command controller includes a program store and a transducer that reproduces selected signals from the program store as command control messages.

123. [6.] An automatic production system comprising:

(a) a workpiece transporter that defines a production line and that carries work-in-process in a substantially horizontal path,

(b) a plurality of automatic [machine] tools having respective local controllers, operating tool heads, and at least one individual tool that performs at least one operation on work aligned with the respective [machine] tools,

(c) respective powered tool transporters that support selected of said plurality of [machine] tools adjacent to the production line and that move said selected [machine] tools [relative to] along said production line under the control of the local controller of the respective [machine] tool,

(d) respective multi-part, flexible manipulator arms, each coupled to move the respective tool head to execute multi-axis travel with respect to the work, each of which arms is coupled to and under the control of the local controller of the respective [machine] tool, [and]

(e) a plurality of stationary work stations adjacent to the workpiece transporter and the tool transporters, and

[(e)] (f) a remote controller including an electronic storage device having a plurality of command control signals stored therein and a reproduction device structured to reproduce from said storage device selected command control signals and coupled to apply said reproduced signals to control operation of the workpiece transporter and the local controller of selected [machine] tools to: (1) predeterminately align work [on the workpiece transporter] at said work stations with respect to selected of said [machine] tools, (2) cause said selected [machine] tools to execute multi-axis movement of their tool heads with respect to the aligned work so as to perform predetermined operations thereon, and (3) cause selected of said plurality of [machine] tool transporters to move along said production line.

124. [7.] An automatic production system in accordance with Claim [6] 123 wherein said respective powered tool transporters move along a common support extending parallel to and above the workpiece transporter.

125. [8.] An automatic production system in accordance with Claim [7] 124 wherein said common support includes a guideway parallel to the production line and a locking device positioned to secure a [machine] tool on said guideway.

126. [9.] An automatic production system in accordance with Claim [6] 123 wherein said tool transporters are disposed on both sides of the production line so as to controllably position respective tools facing opposite sides of work on the production line.

127. [10.] An automatic production system in accordance with Claim [9] 126 wherein said workpiece transporter comprises a conveyor positioned to be driven substantially horizontally, and wherein said tool transporters are supported by a common support comprising a structural beam disposed above and substantially parallel to the workpiece transporter.

128. [94.] The system of Claim [10] 127 wherein said conveyor comprises an endless array of flights.

129. [82.] The system of Claim [6] 123 wherein said workpiece transporter includes a plurality of moveable pallets, each supporting at least one workpiece.

130. [83.] The system of Claim [82] 129 wherein said workpiece transporter includes a plurality of pallets moveable along a track.

131. [84.] The system of Claim [6] 123 wherein said workpiece transporter comprises a conveyor carrying a plurality of spaced-apart workpieces.

132. [85.] The system of Claim [6] 123 wherein said workpiece transporter comprises at least one overhead track and a plurality of work carriers supported by said track, each carrier in turn supporting at least one workpiece.

133. [86.] The system of Claim [6] 123 wherein said tool transporters comprise moveable tool pallets, each pallet supporting at least one tool.

134. [87.] The system of Claim [86] 133 further including a track aligned adjacent to the production line and configured to support and guide said moveable tool pallets.

135. [88.] The system of Claim [6] 123 wherein said plurality of tool transporters together comprise a conveyor carrying a plurality of spaced-apart tools.

136. [89.] The system of Claim [6] 123 wherein said each of said tool transporters is supported by and moveable along at least one overhead track.

137. [90.] The system of Claim [6] 123 wherein said remote controller includes means for applying selected command control signals to predeterminately control operation of the workpiece transporter to align selected units of work and selected [machine] tools.

138. [91.] The system of Claim [6] 123 wherein said remote controller includes means for transmitting signals to align the work and the selected [machine] tools, to cause the selected [machine] tools to perform predetermined operations on the aligned work, and after the predetermined operation is completed, to cause selected [machine] tool transporters to move along the production line.

139. [92.] The system of Claim [6] 123 wherein said remote controller includes means for transmitting signals to cause a selected [machine] tool, while it is aligned with the work, to be stopped along the production line.

140. [93.] The system of Claim [6] 123 wherein said remote controller includes means for transmitting signals to cause a selected [machine] tool, while it is aligned with the work, to move along the production line.

141. [16.] An automatic production system comprising:

(a) at least one work transporter that supports and moves work,

(b) at least one tool transporter disposed proximate to said work transporter,

(c) a plurality of [machine] tools supported for movement on said tool transporter, each comprising an electrically controlled and powered device structured to perform programmed operations on work supported [by] at work stations adjacent to said work transporter,

(d) a local controller associated with each [machine] tool that controls said powered device and including a remotely addressable command signal receiver, and

(e) a remote controller located remote from said [machine] tools structured and coupled to control said work transporter to [align] transfer said work to a work station for alignment with only selected of the [machine] tools and to address the command signal receiver of said local controllers that are associated with the selected [machine] tools to cause said selected tools to perform preprogrammed operations on work aligned therewith.

142. [17.] An automatic production system in accordance with Claim [16] 141 wherein said remote controller controls the operation of a plurality of selected tools to cause said tools to simultaneously perform operations on work supported adjacent to said tools.

143. [18.] A system in accordance with Claim [16] 141 wherein said remote controller controls a plurality of said selected tools to simultaneously operate on a single unit of work located adjacent to said tools.

144. [19.] A system in accordance with Claim [18] 143 wherein said plurality of tools includes a drill operable for drilling holes in work and a tapping tool for tapping such holes to permit fasteners to be secured to said work.

145. [20.] A system in accordance with Claim [18] 143 wherein said plurality of tools include a plurality of welding tools each operable for welding a different portion of said work.

146. [21.] A system in accordance with Claim [18] 143 wherein said plurality of tools includes a plurality of fastening tools each operable to fasten a different portion of said work.

147. [22.] A system in accordance with Claim [18] 143 wherein said plurality of tools includes a plurality of fastener applying tools each operable to apply fasteners to work supported adjacent to said tool.

148. [23.] A system in accordance with Claim [18] 143 wherein said plurality of tools includes a plurality of riveting tools each operable to rivet work disposed adjacent to said tool.

149. [24.] A system in accordance with Claim [16] 141 wherein said plurality of tools includes at least one drilling tool operable to drill holes in work disposed adjacent to said tool and at least one riveting tool operable to apply rivets to the drilled holes and to set said rivets in place.

150. [25.] A system in accordance with Claim [16] 141 wherein:

(a) said tool transporter comprises first and second trackways each disposed adjacent to opposite sides of said work transporter and a bridge crane supported for travel along said first and second trackways above and across said work transporter,

(b) said tools include a carrier supported for movement laterally to a direction of travel of said work transporter by the bridge of said bridge crane, and

(c) said remote controller causes said bridge crane to move in a direction parallel to said work transporter and causes said carrier [for said tool] to move in a direction across said work transporter to predeterminately position [said tool adjacent to] work [on] to said work [transporter] station, and causes said tool to perform programmed operations on said work.

151. [72.] A system in accordance with Claim [16] 141 wherein said remote controller controls a plurality of tools to simultaneously operate on respective units of work located adjacent to said tools.

152. [96.] An automatic production system comprising:

(a) a workpiece transporter defining a production line and structured to carry work-in-process in a substantially horizontal path;

(b) a plurality of automatic [machine] tools, each of said tools having a respective:

(i) local controller,

(ii) base supporting [a manipulator arm,

(iii)] an operating tool head [coupled to the manipulator arm], which is capable of supporting

[(iv)] at least one individual tool [supported by the operating head],

[(v)] (iii) drive system positioned to move said tool on the arm in multi-axis travel with respect to work aligned with said [machine] tool, and

[(vi)] (iv) local electronic storage device associated with said local controller, which storage device stores command control signals applied by the local controller to operate the drive system and the tool to perform at least one operation on work aligned with said [machine] tool;

(c) powered tool transporters coupled to and supporting selected of said plurality of [machine] tools adjacent to the production line, each of said transporters including a power drive that is controllable to move its respective [machine] tool back and forth adjacent to said production line independently of the other [machine] tools;

(d) a remote controller including an electronic storage device that stores a plurality of command control signals and a reproduction system positioned to extract from said storage device selected command control signals; and

(e) a communications system linking the remote controller with the workpiece transporter and the local controllers of said [machine] tools and structured to: (1) communicate selected of said reproduced command control signals to selected local storage devices associated with the local controllers of selected of said [machine] tools so that programmed automatic operations can be carried out on work aligned with said [machine] tools, (2) apply selected of said reproduced command control signals to control the workpiece transporter to cause supported work to move in a controlled manner along the production line relative to said [machine] tools and to position the work at selected work stations, and (3) apply selected of said reproduced command control signals to control the powered tool transporters to selectively move the associated [machine] tools adjacent to the production line to carry out operations on work [moving along the production line] at the selected work stations.

153. [97.] The system of Claim [96] 152 wherein said workpiece transporter comprises a conveyor that supports a plurality of workpieces.

154. [103.] The system of Claim [97] 153 wherein said workpiece transporter comprises a conveyor carrying a plurality of spaced-apart workpieces.

155. [98.] The system of Claim [96] 152 wherein said workpiece transporter comprises at least one moveable pallet.

156. [101.] The system of Claim [98] 155 wherein said workpiece transporter comprises a plurality of moveable pallets, each supporting at least one workpiece.

157. [102.] The system of Claim [101] 156 wherein said workpiece transporter comprises a plurality of pallets moveable along a track.

158. [112.] The system of Claim [101] 156 wherein said communication system includes a transmitter coupled to the remote controller and a receiver coupled to each of said pallets.

159. [100.] The system of Claim [96] 152 wherein said reproduction system of said remote controller includes a transducer that reproduces selected signals from the electronic storage device as command control messages.

160. [104.] The system of Claim [96] 152 wherein said workpiece transporter comprises at least one overhead track and a plurality of work carriers supported by said track, each carrier in turn supporting at least one workpiece.

161. [105.] The system of Claim [96] 152 wherein said tool transporters comprise moveable carriages, each supporting at least one tool.

162. [106.] The system of Claim [96] 152 wherein each of said tool transporters is supported by and moveable along at least one track aligned with the workpiece support.

163. [107.] The system of Claim [106] 162 wherein said track is disposed generally above the production line.

164. [111.] The system of Claim [96] 152 wherein said communication system includes a transmitter coupled to the remote controller and a receiver coupled to the local storage device of each local controller.

165. [113.] The system of Claim [96] 152 wherein said communication system includes a transmitter coupled to the remote controller and a receiver coupled to the power drive of each tool transporter.

166. [29.] (Amended) An automatic production system comprising:

(a) a plurality of tools disposed at respective work positions located spaced apart with respect to each other, [and] each [of said tools] tool including a [respective] tool controller [that controls the operation of the tool],

(b) a conveyor structured to convey units of work to respective work positions [to be operated on by] within range of selected of [said plurality of] the tools,

(c) a remote controller located remote from [said] the tool controllers having an output for [a plurality of] command control signals [operable to] that can effect control of [a tool] any of the tools through [its] their respective tool [controller] controllers, and

(d) a selective addressing system coupling the output of the remote controller to the tool controllers, wherein the selective addressing system is structured to distribute [the] command control signals [from] on the output of the remote controller to the tool controllers, and [for application] wherein distributed command control signals are applied at only a selected [ones] set of [said] the tools by the respective tool controller of each of [said] the selected set of tools to control the selected tool to [automatically] perform tooling operations on a selected unit of work conveyed to the work position within range of the selected tool.

167. [30.] An automatic production system in accordance with Claim [29] 166 wherein said remote controller comprises a master controller located remotely from said tools and said conveyor and wherein said master controller simultaneously controls a plurality of pallets holding a plurality of units of work.

168. [31.] An automatic production system in accordance with Claim [30] 167 wherein said master controller simultaneously controls said plurality of tools to perform respective tooling operations on said plurality of units of work conveyed thereto.

169. [32.] (Amended) A machine system for operating on a plurality of different workpieces requiring different forms of [machining] tool operations performed by a plurality of [machine] tools, each [machine] tool being located at a respective machine work station and each being capable of performing different [machining] tool operations, said machine system comprising:

(a) a conveyor structured to move workpieces along a predetermined [routes to preselected of] path past said machine work stations;

(b) a programmable controller coupled to the [conveyor] tools and structured to select [the predetermined route and] a specific set of machine work stations [along the selected route] to which each of said workpieces is conveyed, [said predetermined routes and] said [preselected] set of machine work stations being [selectively variable] different for different workpieces; and

(c) a transfer device system coupled to the controller and positioned to permit selective transfer of each of the workpieces to only said selected set of machine work stations, so that each of the workpieces follows a [predetermined] selected route defined by the path of the conveyor and the selected set of transfers, to have a [predetermined] selected combination of [machining sequences] tool operations performed thereon under the control of said programmable controller.

170. [33.] A system in accordance with Claim [32] 169 wherein:

(a) said conveyor comprises a plurality of controllable, moveable work pallets;

(b) said programmable controller comprises a master controller located remote from the pallets; and

(c) wherein said master controller simultaneously controls a plurality of said pallets to select the routes and machine work stations to which said plurality of pallets are conveyed.

171. [34.] A machining system for producing articles of manufacture from a plurality of workpieces of different shape, said system comprising:

(a) a plurality of machine tools capable of performing different machining operations on different units of work, each of said machine tools including a local controller having a preselected address;

(b) conveyor means operable for holding a plurality of workpieces, and for conveying each workpiece to only selected of said machine tools;

(c) transport means for transporting workpieces between said conveyor means and only said selected machine tools to permit select machining sequences to be performed on each workpiece; and

(d) programmable control means for selectively controlling the operations of said conveyor means and said transport means for each workpiece and for selectively addressing said selected machine tools for controlling the machining operations of said selected machine tools.

172. [35.] A system for machining a plurality of different workpieces requiring different machining operations, said system comprising:

(a) a plurality of machining means for performing variable machining operations;

(b) means for conveying each workpiece under the control of a programmable control means along a select route of travel defined by preselected stops at only selected of said machining means;

(c) programmable control means for selecting the route of travel and particular machining means and operations for a particular workpiece, and for controlling the conveying means so that said particular workpiece follows said selected route and stops only at said selected machining means to have particular machining operations performed thereon; and

(d) means for selectively transferring a workpiece from said conveyor means to said selected machining means.

173. [36.] (Amended) An automatic production system comprising:

(a) a plurality of [machine] production tools,

(b) conveying means for conveying units of work to only selected of the [machine] tools for performing programmed operations on work carried to said selected tools by said conveying means,

(c) control means for selectively addressing and controlling the operations of said plurality of [machine] tools in performing different operations on selected units of work conveyed to said tools,

(d) automatic inspection means for inspecting work operated on by selected of said tools, and

(e) means for [operating] offloading selected units of work from said conveying means [to dispose selected units of work] for disposition in operative relation with respect to said automatic inspection means, and

(f) wherein said control means also controls the operation of said automatic inspection means in a manner such that, when a unit of work is operatively aligned with said automatic inspection means, said automatic inspection means will perform a select inspection operation with respect to said unit of work.

174. [37.] (Amended) An automatic production system comprising:

(a) a plurality of addressable program controllable [machine] tools, each structured to perform different programmed operations on different units of work,

(b) an automatic conveyor [system] structured to convey different work units only to selected of said tools,

(c) a locator at [each tool] selected of the tools positioned to locate work conveyed to the tool in a predetermined position [to permit] within operating range of the tool [to perform operations on the work],

(d) an automatic programmable inspection system located adjacent to the conveyor and positioned to inspect work operated on by selected of said tools,

(e) a controller structured to generate selected, addressed command control signals and coupled to apply the control signals to the [machine] tools and the inspection system for selectively controlling the operation of said tools and for controlling the operation of said automatic inspection system to perform different inspection functions with respect to different units of work, and

(f) said automatic inspection system including a work-identification subsystem having an output for control signals and coupled to the inspection system to trigger the inspection function applied to a work unit presented for inspection.

175. [38.] An automatic production system in accordance with Claim [37] 174 wherein said automatic inspection system comprises a plurality of separately operable automatic inspection tools.

176. [39.] (Amended) An automatic production system comprising:

(a) a plurality of addressable program-controllable production tool means for performing different programmed operations with respect to different units of work,

(b) automatic conveying means for conveying selected work units to stop only at selected of said tool means to permit the selected tool means to perform select operations with respect to the work units,

(c) work locating and securing means at each of said tool means for prepositioning and holding work conveyed to [and stopped at each] said tool means and removed from the conveying means,

(d) control means for controlling the programmed operations of said tool means,

(e) said control means including (i) memory means having a plurality of command control messages recorded therein, (ii) means for controlling the reproduction of selected of said messages and (iii) for selectively addressing and communicating said reproduced messages to control the operations of said addressed tool means,

(f) means at each tool means for (i) identifying work units conveyed by said automatic conveying means to the vicinity of the tool means and (ii) generating identifying signals, and

(g) means for employing said identifying signals to operate said reproduction control means in a manner to effect the reproduction of selected messages from said memory means and the application of said messages to control the tool means to perform selected programmed operations on the work located at said tool means, and

(h) wherein said control means is also operable for controlling the operation of said work securing means to effect the release of work secured thereby after the tool means has completed its controlled operation on the work to permit the work to be conveyed by said conveying means to another of said selected tool means.

177. [40.] (Amended) An automatic production system comprising in combination:

(a) a plurality of production tools arranged to form a production line in a work area,

(b) a work conveyor including a plurality of separate work carriers and a power drive system for the carriers,

(c) a movement control system structured to [cause] stop said carriers [to stop] only at selected of said production tools,

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(d) a positioning system structured to dispose work stopped at each tool in operative alignment with the tool,

(e) a securing device structured to hold work aligned at each tool, and

(f) a controller coupled to selectively address the plurality of tools and control the operation of each addressed tool on work operatively aligned and secured at the tool to permit the tool to execute a programmed operation on the work, and

(g) said controller further coupled to effect the release of work secured at each tool after the operation of the tool is completed to permit the work to be carried to the next selected production tool along said production line.

178. [41.] An automatic production system in accordance with Claim [40] 177 wherein:

(a) said work conveyor comprises a track supported above said tools,

(b) said plurality of carriers being supported for movement along said track, and

(c) the power drive system includes, for each carrier, a motor supported on and driving each carrier along said track parallel to said production line to carry the work to selected of said tools.

179. [42.] An automatic production system in accordance with Claim [41] 178 wherein the track is a monorail.

180. [43.] An automatic production system in accordance with Claim [40] 177 wherein:

(a) the conveyor comprises an overhead supported bi-rail track with at least one bridge crane supported for movement along said bi-rail track and at least one work carrier suspended from the bridge across each crane, and

(b) the power drive system is structured to move (i) the bridge of each crane along said bi-rail track and (ii) each suspended carrier back and forth along the crane bridge.

181. [45.] An automatic production system for performing different tool operations, such as cutting and shaping operations on different units of work, and wherein the dimensions and shapes of the workpieces vary during the tool operations thereon and wherein quality control is required to properly process work, comprising:

(a) a plurality of selectively addressable, program-controllable, fixed base [machine] tool means for performing the different tool operations on the different units of work,

(b) automatic conveying means for operatively disposing selected of the different work units at selected [machine] tools,

(c) means for automatically addressing and controlling selected [machine] tools to operate on the work units conveyed thereto,

(d) automatic inspection means located proximate to said conveying means for inspecting work after it has been operated on by selected of said tools to determine if the tools have properly performed their automatic operations on the work inspected,

(e) means for effecting predetermined relative alignment between said work and said automatic inspection means,

(f) control means for controlling the operation of said automatic inspection means to cause said inspection means to perform different programmed inspection operations on different units of work,

(g) means for identifying work operatively aligned for inspection by said automatic inspection means and generating code signals identifying said work, and

(h) means for applying said code signals to control the operation of said control means to effect selected inspection operations on different units of work operatively aligned with said inspection means.

182. [46.] An automatic production system in accordance with Claim [45] 181 wherein said automatic inspection means comprises a plurality of automatic inspection machines disposed at different locations in said production system.

183. [47.] An automatic production system in accordance with Claim [46] 182 wherein at least one of said automatic inspection machines is multi-axis in its operation.

184. [48.] (Amended) An automatic production system comprising in combination:

(a) conveying means for supporting and carrying a plurality of pallets, each pallet containing at least one unit of work and being carried along a path to define a production line,

(b) a plurality of production tools, [disposed] each stationed at a location adjacent to the conveying means, with each tool being operable to perform programmed operations on work presented thereto,

(c) at least one of said tools including an automatic inspection device for inspecting work fed thereto and determining the results of the operations of at least some of the others of said tools on work carried by said pallets,

(d) means for aligning palletized work with selected of said tools to operatively locate the work with respect to said selected tools, and

(e) means for generating selectively addressable command control messages and for selectively applying said messages to selected of said tools to predeterminedly control the operation of said selected tools and said automatic inspection device when respective units of work are operatively located with respect thereto to effect preprogrammed operations by said selected tools on said work units and the automatic inspection of such work units after such operations are performed thereon.

185. [49.] (Amended) An automatic production system comprising in combination:

(a) conveying means for supporting and carrying a plurality of pallets with each pallet holding at least one unit of work and being carried along a path to define a production line,

(b) a plurality of production tools disposed adjacent to the conveying means with each tool being operable to perform programmed operations on work presented thereto,

(c) a plurality of pallet transfer and support means disposed adjacent to said first conveying means, with each transport and support means containing (i) means for engaging a pallet conveyed thereto by the conveying means, and (ii) means for fixedly holding said pallets at said production tools to provide the work held thereby in fixed operative relation with respect to said tools,

(d) means for selectively operating said transfer and support means when a selected pallet is presented thereto by the conveying means to selectively transfer said selected pallet into operative relation with respect to a selected tool to which it is conveyed by said conveyor means,

(e) means for operating each pallet engaging means at a respective tool to fixedly hold each pallet presented thereto, and

(f) means for generating selectively addressable command control messages and applying said control messages to control the operation of selectively addressed tools when selected work is operatively located at the tools by the pallets to cause the tools to perform preprogrammed operations on the selected units of work.

186. [50.] (Amended) An automatic production system comprising in combination:

(a) conveying means for supporting and carrying a plurality of pallets with each pallet containing at least one unit of work and travelling a path defining a production line,

(b) a plurality of production tool means disposed adjacent to said conveying means, for performing programmed operations on work presented thereto,

(c) addressable storage means located at each tool means for storing respective command control signals and including means for selectively reproducing control signals therefrom for controlling the tool means,

(d) a plurality of transfer means disposed adjacent to the conveying means for transferring pallets therefrom to respective of said tool means, and means at each tool for operatively locating work with respect to the tool means,

(e) means for selectively operating said transfer means when a selected pallet containing work to be operated on by a selected tool means adjacent to said transfer means is conveyed to the transfer means to cause said transfer means to transfer the selected pallet to the selected tool means,

(f) control means for generating selectively addressable command control messages and means for selectively communicating respective of said messages to selected of said signal storage means, and means for recording the communicated messages in said selected signal storage means for use when reproduced thereafter in controlling respective of the tool means, and

(g) means at each transfer means for (i) identifying pallets on the conveying means, (ii) activating the transfer means when selected pallets are identified to transfer said selected pallets to selected of said production tool means, and (iii) effecting control of the signal storage means of the selected tool means to reproduce selected messages stored thereby and to apply said selected messages to control the selected tool means to perform programmed operations on the work located thereat.

187. [51.] (Amended) An automatic production system comprising in combination:

(a) [first] conveying means for supporting and carrying a plurality of pallets, each containing at least one unit of work, in a given direction defining a production line,

(b) a plurality of addressable production tool means disposed adjacent to said [first] conveying means for performing programmed operations on work presented thereto,

(c) a plurality of pallet transfer means disposed [adjacent] along said conveying means for [engaging] transferring pallets [on] from said [first] conveying means [and for transferring said pallets] to respective of said tools,

(d) control means for generating command control messages, and

(e) means for selectively addressing said pallet transfer means and said tools to selectively apply said command control messages to control the operations of selected of said pallet transfer means and said tools in a manner to effect the transfer of selected work-holding pallets to selected of said tools and to predeterminately control the operation of said selected tools on work held by selected of said pallets and to further effect the transfer of said pallets and work back to said conveying means after said operations have been performed on the work held by said pallets by said tools.

188. [52.] (Amended) An automatic production system comprising in combination:

(a) [first] conveying means for supporting and carrying a plurality of pallets, each pallet holding at least one unit of work, along a given path defining a production line,

(b) a plurality of production tool means disposed adjacent to said [first] conveying means for performing programmed operations on work presented thereto,

(c) a plurality of pallet transfer means disposed [adjacent] along said [first] conveying means for selectively transferring pallets from said conveying means to a position in range of said tool means,

(d) means aligned with each tool means for engaging a pallet transferred to said tool means by said transfer means,

(e) support means for fixedly holding a pallet in a manner to provide the work held by said pallet in fixed operative relation with respect to the tool means, and

(f) control means for generating command control signals and selectively applying said control signals to control the operations of only selected of said pallet transfer means and of said support means to effect the selective transfer of only selected work-holding pallets to only selected of said tool means and the fixed retention of said pallets at the tool means to which they are transferred to permit said tool means to perform programmed operations on the work presented thereto by said pallets.

189. [53.] (Amended) An automatic production system in accordance with Claim [52] 188 wherein said control means is also operable to selectively address and control the programmed operation of each selected tool means after a selected work-holding pallet is transferred from said [first] conveying means to the support means at the tool means and is fixedly held in an operative position.

190. [54.] (Amended) An automatic production system in accordance with Claim [53] 189 wherein said control means is also operable to selectively address and control the operation of selected of said means for fixedly holding pallets in a manner to permit same to hold a selected pallet and fixedly position work held by the pallet with respect to the tool means and to release the pallet to permit the pallet and work to be transferred from the tool support means back to said [first] conveying means.

191. [55.] (Amended) An automatic production system in accordance with Claim [52] 188 wherein said control means is also operable to selectively address and control said pallet transfer devices, after selectively controlling the operation of a tool means to perform on work held by a pallet, to transfer pallets from the pallet support means of the tool means to said [first] conveying means to permit said [first] conveying means to carry pallets to another selected tool means adjacent to said production line.

192. [56.] (Amended) An automatic production system comprising in combination:

(a) a conveyor supporting and carrying a plurality of pallets in a given direction along a select path defining a production line, each pallet holding at least one unit of work,

(b) a plurality of production tools disposed [adjacent to] along said conveyor and structured to perform different programmed operations on different units of work conveyed thereto on said pallets,

(c) a plurality of pallet transfer devices, located adjacent to said conveyor so as to transfer a pallet from said conveyor to dispose it and the work it holds adjacent to at least one selected production tool,

(d) a securing device at each tool structured to engage and hold a pallet at a predetermined location with respect to said tool and to dispose the work held by the pallet in a fixed position with respect to the tool, within operating range of the tool, and

(e) a controller structured to generate and selectively address command control messages to control selected pallet transfer devices, securing devices, and production tools: (1) to transfer selected of said pallets to selected of said tools, and (2) to perform selected programmed operations on selected work supported by said selected pallets.

193. [57.] An automatic production system in accordance with Claim [56] 192 wherein said controller is also structured to control the operations of a plurality of said tools to permit each of said selected tools to simultaneously operate on work presented thereto on said pallets.

194. [59.] (Amended) An automatic production system in accordance with Claim [58] 192 wherein said controller is a master controller [further configured to control] controlling the operations of said securing devices to cause them to hold pallets and to fixedly position work held by said pallets with respect to an associated tool and to release the pallets to permit the pallets and work to be transferred from the associated securing device to said conveyor.

195. [60.] An automatic production system in accordance with Claim [56] 192 wherein said controller is a remote controller located remotely from said pallet transfer devices and their associated tools.

196. [61.] (Amended) An automatic production system comprising in combination:

(a) [first] conveying means for supporting and carrying a plurality of pallets[,] in a given direction defining a production line, each pallet containing at least one unit of work,

(b) a plurality of production tools disposed adjacent to said [first] conveying means, with each tool being operable to perform programmed operations on work presented thereto,

(c) said tools including a plurality of cutting tools operable to cut and remove material from work presented thereto,

(d) said tools also including at least one automatic inspection means for inspecting work fed thereto and detecting the results of the operation of said tools in removing material from said work,

(e) means for transferring palletized work from said [first] conveying means to selected of said tools, and

(f) control means for generating command control messages and selectively distributing and applying said messages to control the operation of said pallet transfer means, selected of said [machine] tools, and said automatic inspection device in a manner to effect the transfer of selected work to only said selected tools, to permit the tools to perform selected programmed operations on work transferred thereto, and to effect the automatic inspection of said work after it is operated on by at least one of said [machine] tools to automatically determine if the [machine] tool has properly performed a programmed operation on said work.

197. [62.] An automatic production system in accordance with Claim [61] 196 including a feedback control system for controlling the operation of said automatic inspection device to permit the device to perform different inspection operations on different units of work.

198. [63.] (Amended) An automatic production system comprising:

(a) a plurality of [machine] tools, each supported on a base that does not move during operation of the production system,

(b) automatic conveying means for conveying units of work to [only] selected of said [machine] tools for the performing of programmed operations on the work units [carried to said] by the selected tools [by said conveying means],

(c) control means for controlling the operations of said [machine] tools when work is disposed at said tools by said conveying means to permit different programmed operations to be performed on different units of work, and

(d) an automatic inspection means disposed proximate to said automatic conveying means,

(e) said automatic inspection means being programmable in its operation, and

(f) said control means being operable to control said conveying means to feed a selected unit of work to said automatic inspection means and to controllably program the operation of said inspection means when a unit of work is disposed thereat to permit said automatic inspection means to perform a selected programmed inspection operation on said work.

199. [64.] An automatic production system in accordance with Claim [63] 198 including feedback control means for said automatic inspection means responsive to a signal generated by said control means for controlling the operation of said automatic inspection means to perform selected inspection operations on different units of work fed to said automatic inspection means.

200. [65.] (Amended) An automatic production system in accordance with Claim [63] 198 wherein said automatic inspection means is located at one of said tools [which] that is operable to machine work, said automatic inspection means being operable to inspect work [which] that is machined by the tool.

201. [66.] An automatic production system in accordance with Claim [65] 200 wherein said machine performs a cutting cycle, and said automatic inspection means is operable to inspect work at the tool during the cutting cycle.

202. [67.] (Amended) An automatic production system comprising in combination:

(a) first means including a plurality of self-propelled conveying means for conveying a plurality of units of work in sequence along a path,

(b) second means including a plurality of variably operable powered tools, [disposed] each of which is stationed during operation of the first means at a different [locations] location adjacent to said path,

(c) third means for generating selectively addressable command control signals in the form of separate machine control messages for use in controlling the operation of said tools,

(d) fourth means at each of said tools for receiving selectively addressed messages generated by said third means,

(e) fifth means for transmitting selectively addressed messages generated by said third means to said receiving means of selected of said tools,

(f) sixth means at each of said tools for applying the selectively received messages to control the operation of said tool, and

(g) seventh means for detecting the presence of work carried by said conveying means when said work is operatively aligned with respective of said tools and for initiating the generation and application of select control signals to control the operation of the tool at which the work is aligned,

(h) said programmed operation on said work being in accordance with the information defined by the selectively addressed messages received at the tool.

203. [68.] An apparatus in accordance with Claim [67] 202 wherein each of said tools is operable to perform controlled operations on work supported by said conveying means while said conveying means is stopped at the tool.

204. [69.] An apparatus in accordance with Claim [67] 202 wherein at least certain of said tools are numerically controllable tools and said selectively addressed control messages are operable to numerically control the operation of said tools to perform programmed operations on work supported by respective of said self-propelled conveying means.

205. [70.] (Amended) An automatic production system comprising in combination:

(a) first means including self-propelled conveyors for conveying a plurality of units of work in sequence along a path,

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(b) second means including a plurality of separately operable and selectively addressable powered tools, [disposed] each of which is stationed during operation of said first means at one of a plurality of different locations [adjacent] along said [given] path,

(c) third means operable to generate selectively addressable command control signals in the form of separate machine control messages for use in controlling the operation of respective of said selectively addressable tools,

(d) fourth means having a specific address at each of said tools for selectively receiving only correspondingly addressed messages generated by said third means,

(e) fifth means for transmitting selectively addressed messages generated by said third means to respective of said receiving means of selected of said tools for controlling the operation of of said tools, and

(f) sixth means for detecting the presence of work on said conveying means when said work is operatively aligned with respective of said tools and for initiating the generation and application of selectively addressed control signals to control the operation of selected of the tools at which said work is aligned to cause said tools to perform a programmed operation on the work supported by the conveying means,

(g) said programmed operation on said work being in accordance with the information defined by the selectively addressed messages received at said tool.

206. [71.] (Amended) An automatic production system comprising in combination:

(a) a power-operated conveyor [for] structured to move a plurality of units of work [moveable] along a path,

(b) a plurality of separately operable powered tools disposed at different locations adjacent to said conveyor,

(c) a selectively addressable command control signal generator, said command control signals arranged in the form of separate messages [for use] useable in controlling the operation of selective of said tools,

(d) a receiver at each of said tools structured to receive messages from said signal generator, said receiver including a specific address,

(e) a transmission system for specifically addressed messages coupling said signal generator and said specifically addressable receivers of selected of said tools, wherein each of said receivers is coupled to the corresponding powered tool so as to permit application of the selectively received messages to control the operation of said selected tools, and

(f) a detector positioned to detect the presence of work conveyed by said conveyor when said work is aligned with a respective tool, wherein said detector is coupled to the corresponding powered tool so as to apply select command control signals received by the receiver corresponding to said tool to

cause the tool to perform a predetermined operation on the work aligned thereat defined by said select command control signals.

207. [72.] (Amended) An automatic production system in accordance with Claim [71] 206 wherein [each] at least one of said tools includes an automatic manipulator having a [manipulation] moveable arm assembly and an operating head supported thereby [containing a power-operated device, a controller for said power-operated device which is controlled in its operation by part of the selectively received messages applied to control the operation of said tool on work aligned thereat].

208. [73.] (Amended) An automatic production system comprising in combination:

(a) a power-operated conveyor structured to carry a plurality of units of work in sequence along a path,

(b) a plurality of separately operable powered tools disposed at different locations adjacent to said conveyor,

(c) a master controller having an output for selectively addressed command control signals arranged in the form of separate messages, and

(d) a receiver at each of said tools including a specific address, said receiver structured to apply only correspondingly addressed messages received from said master controller to control the operation of the tool to selectively operate on work delivered by said conveyor to said selected tool.

209. [79.] The apparatus of claim [73] 208 further comprising a selectively addressable receiver associated with the conveyor, which receiver is coupled to the conveyor so as to apply correspondingly addressed command control signals from the master controller to control operation of the conveyor.

210. [74.] (Amended) An automatic production system comprising in combination:

(a) first means including a power-operated conveying means for conveying a plurality of units of work in sequence along a path,

(b) second means including a plurality of separately addressable tools disposed at different locations adjacent to said conveying means,

(c) third means including control means operative to generate command control signals in the form of separate messages for use in selectively addressing and controlling the operation of selected of said tools, and

(d) fourth means at each of said tools for receiving, recording and reproducing selectively addressed command control signals transmitted from said control means and for applying same to automatically operate on work delivered by said conveying means to said tool.

211. [75.] (Amended) An automatic production system comprising in combination:

(a) first means including power-operated conveying means for conveying a plurality of units of work along a path,

(b) second means including a plurality of individually addressable and separately operable powered tools, [disposed] each of which is stationed during operation of the first means at a different [locations] location adjacent to said conveying means,

(c) third means for generating selectively addressed command control signals in form of separate messages for communication to correspondingly addressed tools for use in controlling the operation of said tools,

(d) fourth means associated with each of said tools and having an individual address identifying said tool for selectively receiving and recording correspondingly addressed messages communicated from said third means and for selectively reproducing said recorded control signals when work is positioned at said [machine] tool,

(e) fifth means for selectively communicating addressed messages generated by said third means to said correspondingly addressed fourth means of selected of said tools and means for applying the received and reproduced messages to control the operation of said respective tools, and

(f) sixth means for detecting the presence of and identifying work conveyed by said conveying means when said work is operatively aligned with a respective tool and for applying select command control signals reproduced from recorded messages to cause the tool to perform a predetermined operation on the work at the tool in accordance with the tool control function defined by said select command control signals.

212. [76.] (Amended) An automatic production system comprising in combination:

(a) conveying means for a plurality of work holding pallets each supporting at least one unit of work, said conveying means being operable to convey said pallets along a select path,

(b) a plurality of work stations located adjacent to said path, each work station having a [machine] tool and power operated means for holding and locating a work pallet at the [machine] tool,

(c) each of said [machine] tools having a power operated tool, first motor means for effecting multi-axis movement of said tool, and respective control means for each of said motor means,

(d) remote control signal generating means for generating addressed tool control signals in the form of command control messages,

(e) each of said work stations having an addressable message signal receiving and recording means,

(f) means for operating said remote control signal generating means to cause it to generate and transmit respective of said addressed command control

messages to correspondingly addressed work station receiving and recording means to effect receipt and recording of select messages at select work stations,

(g) means for identifying each of said work holding pallets when the pallet is conveyed by said conveying means to select work stations and for generating control signals, and

(h) means for applying said latter control signals to effect the [predeterminate positioning] transfer of said work from said conveying means to a predetermined position with respect to the tool of the select work station.

213. [77.] An automatic production system in accordance with Claim [76] 212 wherein the work is predeterminately located on the pallets and the pallets are held and prepositioned at the work stations.

214. [78.] An automatic production system in according with Claim [76] 212 wherein said pallets contain readable codes and said identifying means scans said codes to identify said pallets at said work stations.

215. [29.] An automatic production system comprising:

(a) a plurality of tools [disposed] stationed at respective [work] tool positions located spaced apart with respect to each other, [and] each [of said tools] tool including a [respective] tool controller [that controls the operation of the tool],

(b) a conveyor structured to convey units of work to respective work positions [to be operated on by] within range of selected of [said plurality of] the tools,

(c) a remote controller located remote from [said] the tool controllers having an output for [a plurality of] command control signals [operable to] that can effect control of [a tool] any of the tools through [its] their respective tool [controller] controllers, and

(d) a selective addressing system coupling the output of the remote controller to the tool controllers, wherein the selective addressing system is structured to distribute [the] command control signals [from] on the output of the remote controller to the tool controllers, and [for application] wherein distributed command control signals are applied at only a selected [ones] set of [said] the tools by the respective tool controller of each of [said] the selected set of tools to control the selected tool to [automatically] perform tooling operations on a selected unit of work conveyed to the work position within range of the selected tool.

216. The apparatus of claim 215 wherein the units of work are each secured to a pallet.

217. The apparatus of claim 215 wherein the conveyor is arranged in a straight line.

218. The apparatus of claim 215 wherein the conveyor is substantially horizontal.

219. The apparatus of claim 215 wherein the units of work are supported on top of the conveyor.

220. The apparatus of claim 215 wherein the conveyor carries a plurality of units of work at once.

221. The apparatus of claim 215 wherein the conveyor comprises an endless belt.

222. The apparatus of claim 221 wherein the tools are adjacent to the side of the conveyor belt.

223. The apparatus of claim 215 wherein the conveyor comprises a chain conveyor.

224. The apparatus of claim 215 wherein the conveyor comprises a flight conveyor.

225. The apparatus of claim 215 wherein the conveyor is structured to provide a workpiece support surface that is substantially flat and has two edges parallel to the direction of travel of the conveyor.

226. The apparatus of claim 225 wherein at least some of the tools are adjacent to each of the edges.

227. The apparatus of claim 215 wherein the conveyor moves units of work in a single direction.

228. The apparatus of claim 215 wherein at least one of the tools comprises a cutting machine.

229. The apparatus of claim 215 wherein at least one of the tools comprises a riveting machine.

230. The apparatus of claim 215 wherein at least one of the tools comprises a machining device.

231. The apparatus of claim 215 wherein at least one of the tools comprises a drill.

232. The apparatus of claim 215 wherein at least one of the tools comprises an automatic welder.

233. The apparatus of claim 215 wherein at least one of the tools comprises a fastening machine.

234. The apparatus of claim 215 wherein at least one of the tools comprises a combination drilling-riveting tool.

235. The apparatus of claim 215 wherein at least one of the tools comprises an inspection tool.

236. The apparatus of claim 215 wherein at least one of the tools comprises a camera.

237. The apparatus of claim 215 wherein at least one of the tools comprises a manipulator.

238. The apparatus of claim 215 wherein at least one of the tools comprises a multi-axis manipulator.

239. The apparatus of claim 215 wherein at least one of the tools comprises an articulated manipulator.

240. The apparatus of claim 215 wherein at least one of the tools comprises a grasping device.

241. The apparatus of claim 215 wherein at least one of the tools includes a moveable operating head.

242. The apparatus of claim 241 further comprising a multi-axis drive system coupled to the operating head.

243. The apparatus of claim 242 wherein the operating head is moveable in three dimensions.

244. The apparatus of claim 215 wherein at least one of the tools includes a storage device holding a plurality of control programs, each of which can control the tool to perform different combinations of operations on a unit of work within range of the tool.

245. The apparatus of claim 215 wherein the tools are floor-mounted.

246. The apparatus of claim 215 further comprising a workstation adjacent to the conveyor having at least one tool stationed thereat, and a transfer device positioned to move a unit of work from the conveyor to the workstation.

247. The apparatus of claim 215 further comprising a bridge crane above the conveyor having a carriage moveable across the conveyor in a direction perpendicular to the direction of travel of the units of work on the conveyor.

248. The apparatus of claim 215 wherein the selective addressing system includes a signal receiver coupled to each of the tool controllers.

249. The apparatus of claim 248 wherein the signal receiver includes a code matcher.

250. The apparatus of claim 215 wherein the selective addressing system includes a wireless transmission system.

251. The apparatus of claim 215 wherein the selective addressing system includes a cable with branches extending to each tool.

252. The apparatus of claim 215 wherein the selective addressing system includes a modulated light wave communication system.

253. The apparatus of claim 215 wherein the central controller further comprises a storage device holding tool control programs.

254. The apparatus of claim 215 wherein the central controller is further programmed to control at least some of the tools to perform different operations on different units of work.

255. The apparatus of claim 215 wherein:

(a) the conveyor comprises an endless belt having a support surface that is substantially flat and has two edges parallel to the direction of travel of the conveyor,

(b) the conveyor belt carries a plurality of units of work at once on its top in a single direction along a substantially horizontal path, and

(c) the tools are supported on bases adjacent to the side of the conveyor belt during operation of the conveyor.

256. The apparatus of claim 255 wherein at least some of the tools are adjacent to each of the edges.

257. The apparatus of claim 215 wherein the central controller is further programmed to control at least some of the tools to perform different operations on different units of work, and wherein at least one of the tools comprises:

(a) a multi-axis manipulator having a grasping device and a multi-axis drive system coupled to the grasping device, and

(b) a storage device holding a plurality of control programs, each of which can control the tool to perform different combinations of operations on a unit of work within range of the tool.

258. [29.] An automatic production system comprising:

(a) a plurality of tools disposed at respective work positions located spaced apart with respect to each other, [and] each of said tools including a [respective] tool controller [that controls the operation of the tool],

(b) a conveyor structured to convey units of work to respective work positions to be operated on by selected of said plurality of tools,

(c) a transfer device adjacent to at least one of the work positions and positioned to move selected units of work from the conveyor to the work positions;

[(c)] (d) a remote controller located remote from said tool controllers having an output for a plurality of command control signals operable to effect control of a tool through its tool controller, and

[(d)] (e) a selective addressing system coupling the output of the remote controller to the tool controllers, wherein the selective addressing system is structured to distribute the command control signals from the remote controller to the tool controllers for application at only selected ones of said tools by the respective tool controller of each of said selected tools to control the selected tool to automatically perform tooling operations on a selected unit of work conveyed to the selected tool.

259. [30.] An automatic production system in accordance with Claim [29] 258 wherein said remote controller comprises a master controller located remotely from said tools and said conveyor and wherein said master controller simultaneously controls [a plurality of pallets holding a plurality of units of work] the conveyor and transfer devices.

260. [31.] An automatic production system in accordance with Claim [30] 259 wherein said master controller simultaneously controls said plurality of tools to perform respective tooling operations on said plurality of units of work conveyed [thereto] and transferred to the work positions.

261. [37.] An automatic production system comprising:

(a) a plurality of addressable program controllable [machine] tools, each structured to perform different programmed operations from a stationary position on different units of work,

(b) an automatic conveyor [system] structured to convey different work units only to selected of said stationary tools,

(c) a locator at [each tool] selected of the tools positioned to locate work conveyed to the tool in a predetermined position [to permit] within operating range of the tool [to perform operations on the work],

(d) an automatic programmable inspection system located adjacent to the conveyor and positioned to inspect work operated on by selected of said tools,

(e) a controller structured to generate selected, addressed command control signals and coupled to apply the control signals to the [machine] tools and the inspection system for selectively controlling the operation of said tools and for controlling the operation of said automatic inspection system to perform different inspection functions with respect to different units of work, and

(f) said automatic inspection system including a work-identification subsystem having an output for control signals and coupled to the inspection system to trigger the inspection function applied to a work unit presented for inspection.

262. [38.] An automatic production system in accordance with Claim [37] 261 wherein said automatic inspection system comprises a plurality of separately operable automatic inspection tools.

263. [47.] An automatic production system in accordance with Claim [46] 262 wherein at least one of said automatic inspection [machines] tools is multi-axis in its operation.

264. [72.] An automatic production system in accordance with Claim [72] 261 wherein [each] at least one of said tools includes an automatic manipulator having a [manipulation] moveable arm assembly and an operating head supported thereby [containing a power-operated device, a controller for said power-operated device which is controlled in its operation by part of the selectively received messages applied to control the operation of said tool on work aligned thereat].

265. [37.] An automatic production system comprising:

(a) a plurality of addressable program controllable [machine] tools, each structured to perform different programmed operations on different units of work,

(b) an automatic conveyor [system] structured to convey different work units only to selected of said tools,

(c) a locator at [each tool] selected of the tools positioned to remove work from the conveyor and to locate work conveyed to the tool in a predetermined position [to permit] within operating range of the tool [to perform operations on the work],

(d) an automatic programmable inspection system located adjacent to the conveyor and positioned to inspect work operated on by selected of said tools,

(e) a controller structured to generate selected, addressed command control signals and coupled to apply the control signals to the [machine] tools and the inspection system for selectively controlling the operation of said tools and for controlling the operation of said automatic inspection system to perform different inspection functions with respect to different units of work, and

(f) said automatic inspection system including a work-identification subsystem having an output for control signals and coupled to the inspection system to trigger the inspection function applied to a work unit presented for inspection.

266. [38.] An automatic production system in accordance with Claim [37] 265 wherein said automatic inspection system comprises a plurality of separately operable automatic inspection tools.

267. An automatic production system in accordance with Claim [37] 265 wherein each of said plurality of addressable program controllable [machine] tools are disposed at a stationary position during operation of the conveyor.

268. [40.] An automatic production system comprising in combination:

(a) a plurality of fixed-base production tools [arranged] located to form a production line in a work area,

(b) a work conveyor including a plurality of separate work carriers moveable along the production line and a [power] powered carrier drive system [for the carriers],

(c) a movement control system structured to [cause] stop said carriers [to stop] only at selected of said production tools,

(d) a positioning system structured to dispose work stopped at each tool in operative alignment with the tool,

(e) a securing device structured to hold work aligned at each tool, and

(f) a controller coupled to selectively address the plurality of tools and control the operation of each addressed tool on work operatively aligned and secured at the tool to permit the tool to execute a programmed operation on the work, and

(g) said controller further coupled to effect the release of work secured at each tool after the operation of the tool is completed to permit the work to be carried to the next selected production tool along said production line.

269. [41.] An automatic production system in accordance with Claim [40] 268 wherein:

(a) said work conveyor comprises a track supported above said tools,

(b) said plurality of carriers being supported for movement along said track, and

(c) the power drive system includes, for each carrier, a motor supported on and driving each carrier along said track parallel to said production line to carry the work to selected of said tools.

270. [42.] An automatic production system in accordance with Claim [41] 269 wherein the track is a monorail.

271. [43.] An automatic production system in accordance with Claim [40] 268 wherein:

(a) the conveyor comprises an overhead supported bi-rail track with at least one bridge crane supported for movement along said bi-rail track and at least one work carrier suspended from the bridge across each crane, and

(b) the power drive system is structured to move (i) the bridge of each crane along said bi-rail track and (ii) each suspended carrier back and forth along the crane bridge.

272. [72.] An automatic production system in accordance with Claim [72] 268 wherein [each] at least one of said tools includes an automatic manipulator having a [manipulation] moveable arm assembly and an operating head supported thereby [containing a power-operated device, a controller for said power-operated device which is controlled in its operation by part of the selectively received messages applied to control the operation of said tool on work aligned thereat].

273. [40.] An automatic production system comprising in combination:

(a) a plurality of production tools arranged to form a production line in a work area,

(b) a work conveyor including a plurality of separate work carriers and a power drive system for the carriers,

(c) a movement control system structured to [cause] detach said carriers from said power drive system and to stop only at selected of said production tools,

(d) a positioning system structured to dispose work stopped at each tool in operative alignment with the tool,

(e) a securing device structured to hold work aligned at each tool, and

(f) a controller coupled to selectively address the plurality of tools and control the operation of each addressed tool on work operatively aligned and secured at the tool to permit the tool to execute a programmed operation on the work, and

(g) said controller further coupled to effect the release of work secured at each tool after the operation of the tool is completed to permit the work to be carried to the next selected production tool along said production line.

274. An automatic production system in accordance with Claim [40] 273 wherein the plurality of production tools have fixed bases.

275. [71.] An automatic production system comprising in combination:

(a) a power-operated conveyor [for] structured to move a plurality of units of work [moveable] along a path,

(b) a plurality of separately operable powered tools, each disposed during operation of said conveyor at different fixed locations adjacent to and along said conveyor,

(c) a selectively addressable command control signal generator, said command control signals arranged in the form of separate messages [for use] useable in controlling the operation of selective of said tools,

(d) a receiver at each of said tools structured to receive messages from said signal generator, said receiver including a specific address,

(e) a transmission system for specifically addressed messages coupling said signal generator and said specifically addressable receivers of selected of said tools, wherein each of said receivers is coupled to the corresponding

powered tool so as to permit application of the selectively received messages to control the operation of said selected tools, and

(f) a detector positioned to detect the presence of work conveyed by said conveyor when said work is aligned with a respective tool, wherein said detector is coupled to the corresponding powered tool so as to apply select command control signals received by the receiver corresponding to said tool to cause the tool to perform a predetermined operation on the work aligned thereat defined by said select command control signals.

276. [72.] An automatic production system in accordance with Claim [71] 275 wherein [each] at least one of said tools includes an automatic manipulator having a [manipulation] moveable arm assembly and an operating head supported thereby [containing a power-operated device, a controller for said power-operated device which is controlled in its operation by part of the selectively received messages applied to control the operation of said tool on work aligned thereat].

277. [72.] An automatic production system in accordance with Claim [71] 276 wherein [each of said tools includes an] a power-operated device supported by the operating head of said automatic manipulator [having a manipulation arm assembly and an operating head supported thereby containing a power-operated device, a controller for said power-operated device which] is controlled [in its operation] by part of the selectively received messages applied to control the operation of said tool on work aligned thereat.

278. An automatic production system in accordance with Claim [71] 275 wherein at least one of said tools includes a moveable operating head.

279. [71.] An automatic production system comprising in combination:

(a) a power-operated conveyor [for] structured to move a plurality of units of work [moveable] along a path,

(b) a plurality of separately operable powered tools disposed at different locations adjacent to said conveyor,

(c) a selectively addressable command control signal generator, said command control signals arranged in the form of separate messages [for use] useable in controlling the operation of selective of said tools,

(d) a receiver at each of said tools structured to receive messages from said signal generator, said receiver including a specific address,

(e) a transmission system for specifically addressed messages coupling said signal generator and said specifically addressable receivers of selected of said tools, wherein each of said receivers is coupled to the corresponding powered tool so as to permit application of the selectively received messages to control the operation of said selected tools, [and]

(f) a detector positioned to detect the presence of work conveyed by said conveyor when said work is aligned with a respective tool, and

(g) a transfer device responsive to the detector and structured and positioned to transfer aligned units of work from the conveyor to the work station,

(h) wherein said detector is coupled to the corresponding powered tool so as to apply select command control signals received by the receiver corresponding to said tool to cause the tool to perform a predetermined operation on the work aligned thereat defined by said select command control signals.

280. An automatic production system in accordance with Claim [71] 279 wherein each of said tools are stationed at the respective work stations during operation of the conveyor.

281. [73.] An automatic production system comprising in combination:

(a) a power-operated conveyor structured to carry a plurality of units of work in sequence along a path,

(b) a plurality of separately operable powered tools, [disposed] each stationed during operation of said conveyor at different locations adjacent to said conveyor,

(c) a [master] central controller having an output for selectively addressed command control signals arranged in the form of separate messages, and

(d) a receiver at each of said tools including a specific address, said receiver structured to apply only correspondingly addressed messages received from said master controller to control the operation of the tool to selectively operate on work delivered by said conveyor to said selected tool.

282. [79.] The apparatus of claim [73] 281 further comprising a selectively addressable receiver associated with the conveyor, which receiver is coupled to the conveyor so as to apply correspondingly addressed command control signals from the [master] central controller to control operation of the conveyor.

283. The apparatus of claim 281 wherein the units of work are each secured to a pallet.

284. The apparatus of claim 281 wherein the conveyor is arranged in a straight line.

285. The apparatus of claim 281 wherein the conveyor is substantially horizontal.

286. The apparatus of claim 281 wherein the units of work are supported on top of the conveyor.

287. The apparatus of claim 281 wherein the conveyor comprises an endless belt.

288. The apparatus of claim 287 wherein the tools are adjacent to the side of the conveyor belt.

289. The apparatus of claim 281 wherein the conveyor comprises a chain conveyor.

290. The apparatus of claim 281 wherein the conveyor comprises a flight conveyor.

291. The apparatus of claim 281 wherein the conveyor is structured to provide a workpiece support surface that is substantially flat and has two edges parallel to the path.

292. The apparatus of claim 291 wherein at least some of the tools are adjacent to each of the edges.

293. The apparatus of claim 281 wherein the conveyor moves units of work in a single direction.

294. The apparatus of claim 281 wherein at least one of the tools comprises a cutting machine.

295. The apparatus of claim 281 wherein at least one of the tools comprises a riveting machine.

296. The apparatus of claim 281 wherein at least one of the tools comprises a machining device.

297. The apparatus of claim 281 wherein at least one of the tools comprises a drill.

298. The apparatus of claim 281 wherein at least one of the tools comprises an automatic welder.

299. The apparatus of claim 281 wherein at least one of the tools comprises a fastening machine.

300. The apparatus of claim 281 wherein at least one of the tools comprises a combination drilling-riveting tool.

301. The apparatus of claim 281 wherein at least one of the tools comprises an inspection tool.

302. The apparatus of claim 281 wherein at least one of the tools comprises a camera.

303. The apparatus of claim 281 wherein at least one of the tools comprises a manipulator.

304. The apparatus of claim 281 wherein at least one of the tools comprises a multi-axis manipulator.

305. The apparatus of claim 281 wherein at least one of the tools comprises an articulated manipulator.

306. The apparatus of claim 281 wherein at least one of the tools comprises a grasping device.

307. The apparatus of claim 281 wherein at least one of the tools includes a moveable operating head.

308. The apparatus of claim 307 further comprising a multi-axis drive system coupled to the operating head.

309. The apparatus of claim 308 wherein the operating head is moveable in three dimensions.

310. The apparatus of claim 281 wherein at least one of the tools includes a storage device holding a plurality of control programs, each of which can control the tool to perform different combinations of operations on a unit of work within range of the tool.

311. The apparatus of claim 281 wherein the tools are floor-mounted.

312. The apparatus of claim 281 further comprising a workstation adjacent to the conveyor having at least one tool stationed thereat, and a transfer device positioned to move a unit of work from the conveyor to the workstation.

313. The apparatus of claim 281 further comprising a bridge crane above the conveyor having a carriage moveable across the conveyor in a direction perpendicular to the path.

314. The apparatus of claim 313 wherein the receiver includes a code matcher.

315. The apparatus of claim 281 wherein the central controller and the receivers at the tools are structured to transmit the messages via wireless transmission.

316. The apparatus of claim 281 wherein the central controller and the receivers at the tools are coupled with a cable having branches extending to each tool.

317. The apparatus of claim 281 wherein the central controller and the receivers at the tools are structured to transmit the messages via modulated light wave communication.

318. The apparatus of claim 281 wherein the central controller further comprises a storage device holding tool control programs.

319. The apparatus of claim 281 wherein the central controller is further programmed to control at least some of the tools to perform different operations on different units of work.

320. The apparatus of claim 281 wherein:

(a) the conveyor comprises an endless belt having a support surface that is substantially flat and has two edges parallel to the path,

(b) the conveyor belt carries the plurality of units of work on its top in a single direction along a substantially horizontal path, and

(c) the tools are supported on bases adjacent to the side of the conveyor belt during operation of the conveyor.

321. The apparatus of claim 320 wherein at least some of the tools are adjacent to each of the edges.

322. The apparatus of claim 281 wherein the master controller is further programmed to control at least some of the tools to perform different operations on different units of work, and wherein at least one of the tools comprises:

(a) a multi-axis manipulator having a grasping device and a multi-axis drive system coupled to the grasping device, and

(b) a storage device coupled to the receiver and holding a plurality of control programs, each of which can control the tool to perform different combinations of operations on a unit of work within range of the tool.

323. [73.] An automatic production system comprising in combination:

(a) a power-operated conveyor structured to carry a plurality of units of work in sequence along a path,

(b) a plurality of separately operable powered tools disposed at different [locations] work stations adjacent to said conveyor,

(c) a plurality of transfer devices associated with at least some of the work stations and configured to move selected units of work from the conveyor to the work stations;

[(c)] (d) a master controller having an output for selectively addressed command control signals arranged in the form of separate messages, and

[(d)] (e) a receiver at each of said tools including a specific address, said receiver structured to apply only correspondingly addressed messages received from said master controller to control the operation of the tool to selectively operate on work delivered by said conveyor to said selected tool.

324. The apparatus of claim [73] 323 wherein each of the tools are stationed at a respective one of the work stations during operation of the conveyor.

325. [79.] The apparatus of claim [73] 324 further comprising a selectively addressable receiver associated with the conveyor, which receiver is coupled to the conveyor so as to apply correspondingly addressed command control signals from the master controller to control operation of the conveyor.

326. An automatic production system comprising:

(a) a multi-workpiece conveyor extending along a path;

(b) a plurality of power-operated tools, each stationed at a work position along the path and adjacent to the conveyor;

(c) a central controller electronically coupled to the tools and to the conveyor; and

(d) wherein the central controller is programmed to direct the conveyor to cause workpieces passing along the path to stop at a selected subset of the work positions and bypass the other work positions, wherein the selected subset of work positions is different for different workpieces, so that different tools operate on different workpieces.

327. The apparatus of claim 326 wherein the workpieces consist of individual units of work each secured to a pallet.

328. The apparatus of claim 326 wherein the conveyor is arranged in a straight line.

329. The apparatus of claim 326 wherein the path is substantially horizontal.

330. The apparatus of claim 326 wherein the workpieces are supported on top of the conveyor.

331. The apparatus of claim 326 wherein the conveyor carries a plurality of workpieces at once along the path.

332. The apparatus of claim 326 wherein the conveyor comprises an endless belt.

333. The apparatus of claim 332 wherein the tools are adjacent to the side of the conveyor belt.

334. The apparatus of claim 326 wherein the conveyor comprises a chain conveyor.

335. The apparatus of claim 326 wherein the conveyor comprises a flight conveyor.

336. The apparatus of claim 326 wherein the conveyor is structured to provide a workpiece support surface that is substantially flat and has two edges parallel to the path.

337. The apparatus of claim 336 wherein at least some of the tools are adjacent to each of the edges.

338. The apparatus of claim 326 wherein the conveyor moves workpieces in a single direction.

339. The apparatus of claim 326 wherein at least one of the tools comprises a cutting machine.

340. The apparatus of claim 326 wherein at least one of the tools comprises a riveting machine.

341. The apparatus of claim 326 wherein at least one of the tools comprises a machining device.

342. The apparatus of claim 326 wherein at least one of the tools comprises a drill.

343. The apparatus of claim 326 wherein at least one of the tools comprises an automatic welder.

344. The apparatus of claim 326 wherein at least one of the tools comprises a fastening machine.

345. The apparatus of claim 326 wherein at least one of the tools comprises a combination drilling-riveting tool.

346. The apparatus of claim 326 wherein at least one of the tools comprises an inspection tool.

347. The apparatus of claim 326 wherein at least one of the tools comprises a camera.

348. The apparatus of claim 326 wherein at least one of the tools comprises a manipulator.

349. The apparatus of claim 326 wherein at least one of the tools comprises a multi-axis manipulator.

350. The apparatus of claim 326 wherein at least one of the tools comprises an articulated manipulator.

351. The apparatus of claim 326 wherein at least one of the tools comprises a grasping device.

352. The apparatus of claim 326 wherein at least one of the tools includes a moveable operating head.

353. The apparatus of claim 352 further comprising a multi-axis drive system coupled to the operating head.

354. The apparatus of claim 353 wherein the operating head is moveable in three dimensions.

355. The apparatus of claim 326 wherein at least one of the tools includes a storage device holding a plurality of control programs, each of which can control the tool to perform different combinations of operations on a workpiece within range of the tool.

356. The apparatus of claim 326 wherein the tools are supported on fixed bases.

357. The apparatus of claim 326 further comprising a workstation adjacent to the conveyor having at least one tool stationed thereat, and a transfer device positioned to move a workpiece from the conveyor to the workstation.

358. The apparatus of claim 326 further comprising a bridge crane above the conveyor having a carriage moveable across the conveyor in a direction perpendicular to the path.

359. The apparatus of claim 326 further comprising a signal receiver associated with at least one of the tools.

360. The apparatus of claim 359 wherein the signal receiver is addressable.

361. The apparatus of claim 359 further comprising a code matcher coupled to the signal receiver.

362. The apparatus of claim 326 further comprising selectively addressable receivers at the tools, and wherein the receivers are coupled to the central controller.

363. The apparatus of claim 362 wherein the coupling is wireless.

364. The apparatus of claim 326 wherein the coupling is cabled.

365. The apparatus of claim 326 wherein the coupling is via modulated light waves.

366. The apparatus of claim 326 wherein the central controller further comprises a storage device holding tool control programs.

367. The apparatus of claim 326 wherein the central controller is further programmed to control at least some of the tools to perform different operations on different workpieces.

368. The apparatus of claim 326 wherein:

(a) the path is substantially horizontal;

(b) the conveyor comprises an endless belt having a workpiece support surface that is substantially flat and has two edges parallel to the path,

(c) the conveyor belt carries a plurality of workpieces at once on its top in a single direction, and

(d) the tools are supported on bases adjacent to the side of the conveyor belt during operation of the conveyor.

369. The apparatus of claim 368 wherein at least some of the tools are adjacent to each of the edges.

370. The apparatus of claim 326 wherein the central controller is further programmed to control at least some of the tools to perform different operations on different workpieces, and wherein at least one of the tools comprises:

(a) a multi-axis manipulator having a grasping device and a multi-axis drive system coupled to the grasping device,

(b) a storage device holding a plurality of control programs, each of which can control the tool to perform different combinations of operations on a workpiece within range of the tool, and

(c) an addressable signal receiver coupled to the central controller.